

**A STUDY OF COMBINATORIAL REASONING
USING SIXTEEN BINARY OPERATIONS
DURING ADOLESCENCE**

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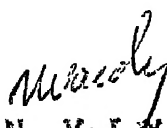
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C E R T I F I C A T E

This is to certify that Miss Abha Sharma,
student of M.Ed. of Regional College of Education, Ajmer
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entitled " A STUDY OF COMBINATORIAL REASONING USING
SIXTEEN BINARY OPERATIONS DURING ADOLESCENCE" under
my guidance and supervision.

Her work is genuine and original.

March 7, 1988


(DR. N. V. SHARMA)
PRINCIPAL

A C K N O W L E D G E M E N T

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CHAPTER I

BACKGROUND OF THE PROBLEM

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Cognitive development is a dynamic process, influenced by both environment and maturation. Piaget has explained the process of cognitive development in terms of an invariant sequence of qualitatively different stages with each stage necessary for launching one on to the next.

STAGES OF COGNITIVE DEVELOPMENT

Piaget's most significant contribution to contemporary educational thought and practice has been his characterization of specific cognitive developmental stages of children. Piaget has divided the periods of cognitive development into four major developmental stages. Each stage reflects a range of organizational patterns which occur in a definite sequence within an approximate age span in the continuum of development. Piaget(1953) has identified these stages as follows :

1. The Sensory motor stage,
2. The Pre-operational stage,
3. The Concrete-operational stage,
4. The Formal-operational stage.

Though pre-operational and concrete operational stages are of great significance for educationists and psychologists in order to understand the sequence of cognitive development and availability of logical structures at each stage but the present study is related with adolescents who all are above the age of

11+ so it is imperative to elaborate the formal operational stage.

1. SENSORY MOTOR STAGE

During this period developing organism achieves practical knowledge, within, this period, Piaget has identified six sub-stages (i) The use of reflexes, (ii) the first acquired adaptation and the primary circular reaction, (iii) The secondary circular reactions and the procedures dislind to make interesting sight last, (iv) the coordination of the secondary schemata and their application to new situations, (v) the tertiary circular reaction and the discovery of new means, through active experimentation and (vi) the invention of new means through mental combinations.

According to Piaget, simple reflexes of new born child have become acquired adaptation as a result of interaction with the environment.

In second substages a circular reaction refers to the repetition of a sensory motor responses which results are not anticipated. The third sub-stages, is characterized by achievement of assimilation in reproducing, reorganizing and generating assimilation. The fourth sub-stages is a period of solidary transform actions and marks "the first actually intelligent behaviour patterns." In fifth sub-stage, organism builds on the major achievement of the

(a) the evolution of a method for conserving new acquisitions and transforming them into schemata,
(b) the integration of schemata in means ends relationships to innate intentional grouping of behaviour.
In sixth sub-stages, organism displays the most advanced form of goal directed behaviour and moves towards the level of preconceptual thought.

(2) THE PRE-OPERATIONAL STAGE:

In this stage language and symbolic thought have their beginnings therefore this stage provides the autogenetic origin for thought.

Entry into this stages requires the reconstruction which is essence amounts to translation without contradiction, preoperational thought is the ideas of "representation" with the related learners ability to differentiate between them.

Imitations i.e., the active replication of some Model event is the product of accomodation. And the role of assimilation in developing symbols is to supply significant for the signifiers, which have been driven through invitation. Perhaps, the most limited characteristics of the preoperational thought is its irreversibility. Piaget has splitted this stage into two sub-stages : transductive (2-4 years) and inductive (4-7 years).

At the sub-stage I, child fails to construct hierarchical arrangements, because after a short while he forgets the defining properties. In sub-stage II, the child acquires a mode of dealing with many of the problems of integrating different view points and informations from different sources. Though child can get correct way of a problem but he still does not have a clear conceptual representation.

3. THE CONCRETE OPERATIONAL STAGE

The child is able to direct his attention away from the static conditions and can focus on the whole set of successive changes that occurs in the process of transformation. The starting point of concrete operations is always the real rather than potential. During this period, there are some logical inconsistencies in the child's thinking call this efficiency 'Cyncretism'.

The two fundamental types of concrete operations are : Logico-mathematical operation and spatial operation (Piaget, 1967), Piaget have divided operations during this stage into two main groups logical and infra-logical. The logical operations such as establishing one to one correspondence, adding and subtracting are not tied to any specific quantities, space, time or the like as are the infra-logical operations (Good, 1977).

According to Flavell (1963) organism operates with representational thought instead of direct action on the object. The concrete operational cognitive structure is more flexible, more consistent, more enduring. Student has rich and integrated assimilatory organization in equilibrium with a discriminative accommodation mechanism. Piaget introduces non-psychological concept of group, "lattice" and "grouping". Piaget has identified eight groupings, which depend upon group and lattice properties for their various characteristics.

4. THE FORMAL OPERATIONAL STAGE:

The approximate age range for one set of this stage being 11 to 16 years, it appears to be synonymous with the transitional stage called, Adolescence. This is the most crucial and challenging period so, is usually portrayed as a period of trouble and turmoil. Adolescents are pictured as being in a stage of constant and unrelieved conflict between the desire to remain children and the need to assume responsibility of adulthood. They are said to be emotionally unstable. Piaget, in sharp contrast to traditional view, regards this period as the most exhilarating and productive time of life. It is the time when simple answers to the burning questions are just not good enough. Unlike, the concrete-operational thought which operates on hard tangible facts only, the Formal-operational

thought is not tied up with perception and memory.

"(He) can now reason on hypothesis and not only on objects but, he constructed new operations, operations of propositional logic and not simply the operations of classes, relations and members. He attains new structures, which are on the one hand combinatorial, corresponding to what mathematicians call lattices, on the other hand more complicated group structure. At the level of concrete operations the operations apply within an immediate neighbourhood." (Phipple and Rock Castle, 1964).

In this stage the complexity of organizing reality has given way to the elegance of the possible, or as Flowell says (1963) that where the concrete-operational child deals with what is the more mature learner, using the Formal operations of intelligent behaviour, deals with what might be.

The most distinctive features of Formal operational thought is that the organism attempts problem-solving with abstract considerations of possible solutions, according to the relationships between the elements of the problem. This type of problem-solver will use logical analysis and combinatorial experimentation. He sees reality as a subset of all that is possible and has undergone a fundamental reorientation in his approach to the problem task.

the three major characteristics of the developmental stage are :

- (i) a base in a hypothetico-deductive model.
- (ii) the use of propositional reasoning and finally,
- (iii) the use of combinatorial analysis.

Hypothetico-deductive reasoning means that the learner, manipulates propositions containing the data of reality, but he is not limited to reality, as in concrete operator. The formal operator organizes concrete structure by accomodation and assimilation and evolves propositions and operates on them, thereby producing logical and testable statements by means of "implication, connection, conjunction and identity". Implications is the ability to embed one thought in another, connections means , the merging of two or more propositions, conjunction is the linking of multiple propositions, and identify is the presence of two, equal elements in propositions.

COMBINATORIAL REASONING AND INRC

Identifying and controlling experimental variables in a systematic way assumes an underlying combinatorial, system. Before these combinations are random but later systematic and complex. At formal stage the child adopts a step by step combination method with generalization (Gruber and Vonchh, 1977).

Combinatorial analysis is an abstract-approach to problem-solving unique to formal operations. The learner using combinatorial analysis for isolating all the elements of a propositions and then recombined them in all possible ways. This "second degree grouping of operations". (Piaget, 1950) constitutes the structure of final equilibrium towards which concrete operation tend. The same operational content is involved : classing, serating, numbering and measuring. However, although there is an essential relationship between concrete and formal operational, there is a vertical separation between them, that is, a different psychological problem is evolved (Piaget, 1950).

Piaget (1967) summarizes the three "novelties" of the formal stage ;

- a) There is a generalization of classification leading to the classification of the second degree, called the 'combinatorial'.

- b) This combinatorial allows the addition proposition operations (p,q etc.) to the operations of classes and relations. This implies a more general form of logic in which the form is independent of the content.
- c) This formal structure thus become completely reversible with N and R. there is then a complete group of four transformations: I=NRC. This INRC group is a set of four operations i.e. Identity, Negation, Reciprocity and correlation operation.

Thus the organization of thought moves away from "thing" towards "ideas" and it involves deducing conclusion from proposition rather than facts actually verified by the adolescents.

CRITIQUE OF PIAGET THEORY

The work of piaget has been criticized on different grounds by several workers. They are: montghes (1966), Kagan (1960), Seiler (1973), Overtone and Reese (1973), Rottentreich (1975), Totilman (1976), Harten (1977), Tripp (1978), Pascual Leone (1980) etc. Their criticism has been summarized by Vuyk, Rita (1981) in her recent publication entitled "Overview and critique of Piaget's Genetic Epistemology" 1965-1980 Academic Press INC (London, 1981).

1. Piaget's assumption that the adolescent reflects on the combinatorial system as a whole and that such reflection facilitates effective thinking is unjustified.
2. Piaget's theory of formal operations is wrong because not all adolescents can solve the 'tests' for formal operations.
3. Adolescents are not as good in logical reasoning as piaget claims.
4. Many young children are quite capable of syllogistic and conditional reasoning though Piaget says that they are not.
5. We haven't adequately clarified precisely what we mean by formal operations, in both the methodological and the formal definitional senses.
6. Piaget gives no clear criteria for deciding that adolescents do "work within the combinatorial system" while children are supposed to be incapable of doing so.
7. "Reasoning is radically affected by content in a systematic way; and this is incompatible with the Piagetian view that in formal operational thought the content of a problem has at last been subordinated to the form of relations in it".

8. Piaget makes number of blunders due to his lack of knowledge of elementary mathematics and physics.
9. He never accepts falsifications of his experimental results of his critics.
10. His experiments look very simple but are infact, too complex for a detailed analysis.
11. Piaget is wrong in claiming that philosophy does not give us truth but that science does.
12. He does not know of recent development in cognitive psychology, information processing, psychology of thinking etc.

Piaget provided rich model of investigating not only for learning but also for teaching. His ideas are still at the conjectural stage which is under scrutiny all over the English speaking world.

JUSTIFICATION OF THE PROBLEM

Much of the research work has been done on adolescence stage. Adolescence is a very important period as suggested by Prof. Jean Piaget. At adolescence, individual mind becomes truly experimental, because he makes hypothesis and test them by experimentation. Due to its anomalous nature, but most of the studies of this stage were related to social life longitudinal research on this stage helps us to

appreciate. The importance of adolescence in the total life how it builds on childhood experience and constitutes a transition to the future (Anderson,1979) while cross cultural cross sectional studies compares the cultures and different aspects of development. Most of the studies concentrated only on the determinations of various stages of development (concrete, post concrete and formal) on which child operates. While other studies also have tried to find out the relationship of each stages of thought with different variables like personality linguistic abilities. In this study only one scheme of thought has take fifteen plus one items based on Piaget type items to measures the combinatorial reasoning, adolescent thoughts and its relates with academic achievement.

STATEMENT OF THE PROBLEM

The purpose of this study is to investigate growth of logical thinking and its relationship with Academic Achievement. In precise the purpose of study may be stated as :

" A STUDY OF COMBINATORIAL REASONING USING SIXTEEN BINARY OPERATIONS DURING ADOLESCENCE".

PRESENT STUDY AT A GLANCE

The present study has been described in six chapters excluding appendix and bibliography.

The first chapter deals with the background of the Piagetian thinking and problem solving ability. The second chapter deals with the related research studies and the summary of findings of these studies. The distinct features of the present study in the light of the various related literature are also presented in the same chapter. The plan and procedure of the study are discussed in the third chapter. It deals with the selection of the sample, data gathering instruments, their administration, scoring objective and hypotheses etc. The responses on the tests and their analysis are presented in the chapter fourth. The mean, and SD for the various tests used, are presented in the same chapter. The results of statistical analysis, discussions and conclusions are presented in the chapter fifth. The chapter sixth deals with the summary of the study, educational implications, problems for the further research etc.

CHAPTER II

REVIEW OF THE RELATED
LITERATURE

CHAPTER II

REVIEW OF THE RELATED LITERATURE.

INTRODUCTION

The Review of the literature is critical aspect of the planning of the study. So the research for reference material is fruitful phase of the research programme. It provides a depth understanding of the type of research work going on in the field, and it also provides one with means of getting to the frontier in a particular field of knowledge.

Adolescence is a period of affliction, uneasiness, distress, turmoil, and agitation on the one hand productive, interesting, and exhilarating instances on the other hand. At this stage a child matures physically, physiologically, psychologically and socially. According to Rogers (1981), "adolescence is a process rather than a time period, a process of achieving the attitudes and beliefs in society". It

may be interpreted in another ways as well as a period of physical development, as a socio cultural phenomena, or even abstractly as an attitude towards life. Defined chronologically, or in terms of calender years, adolescence embraces the period 12 or 15 years of age until 18 or 22. adolescence is often viewed as a transition, a link between childhood and adulthood with no genuine essence of its own.

Survey of the related literature is necessary for scientific approach as well as for theoritical and experimental work. It also develops an insight into the problem to be investigated. It is necessary to know about the researches which have been done and which remains to be done in that particular field. 'Host' states that, "To know that source to use, what source are available and where and how to find them will have many houses of aimless activity".

Much of the research work has been done on Adolescent stage due to its anomolous nature. Adolescence, research has its special methowologies and deficiencies.

Longitudinal research on the stage help us to appreciate the importance of adolescence in the total life how it builds on childhood experience and constitutes a transition to the future (Anderson, 1979) while other research studies have been concentrated

only on the determination of the various stages of development (concrete, post-concrete and formal) on which a child operates. Very few studies tried to analyse the various dimensions of adolescent thought with its mathematical structure. In this study sixteen binary operations based on combinatorial reasoning are taken to measure the dimensions of adolescent thought.

The present study has been restricted to the area of combinatorial reasoning and its relationship with achievement. The area wise related studies are given below.

JUSTIFICATION WITH REVIEWED LITERATURE

The researcher has tried to scan out the needed studies in the aforesaid areas and during his hunt for related literature, it was observed that the studies in particular area have been given citation in combinations of different variables, in different grounds of repuleforeign as well as Indians. The researcher has tried his best to complete the necessary studies as related to this project, but these should be viewed as whole, "not in different directions".

SOME RELATED STUDIES

Vaidya (1964) investigated problem solving in science among certain groups of adolescent pupils (15⁺) using questionnaire approach (N=60) as well as interview approach (N=31), found that adolescent pupils do not hesitate to criticize data. Secondly, there is a general tendency among adolescent pupils to set up hypotheses which they test against the given data. Thirdly, a poor problem solver appears to stick to one data at a time, stubbornly and, later on, ceases to think of alternative idea. He also observed that adolescent pupils solve science problem over a wide I.Q. range.

Lawson, Nordland and Devito (1974) analysed response on five Piagetian formal operational tasks in a test-retest method to determine the extent to which taking pre-test affected scores on post-tests. Seventeen college freshmen and nineteen college sophomores enrolled in course, and elementary school teachers served as a subject (34 females and 2 males) ranged in age from 17.5 to 20.0 years with the median age 18.5 years. The five tasks : Conservation of volume and metal cylinder tasks, Exclusion of variables, Separation of variables and Equilibrium in the balance were taken with pre-test and post-test interviews. The significant gains made on the two conservation of volume obviously do not indicate cognitive. Although

direct physical experience is necessary for cognitive growth. Test-retest tasks reliabilities ranged widely.

Lawson (1975) in study of 'Sex differences in concrete and formal reasoning ability as measured by manipulative tasks and written tasks'. A sample of 62 high school students (31 males and 31 females) were randomly selected for this study. Results showed that males performed significantly better than females on manipulative tasks, but the differences between the males and females on written tasks were less than the former. Both written and manipulative measured different parameters.

Shayer and Wylam (1978) in the Distribution of Piagetian stages of Thinking in British Middle and Secondary School Children of 14 to 16 years old, found the girls' performance substantially low on the test on relationships on volume and density.

Vaidya (1979) studied 'The Growth of Logical Thinking in Science during Adolescence' on a sample of 100 boys and 100 girls, studying in grade VI to X matched on intelligence and socio-economic status. The main findings of this study are:

1. Except for occasional fluctuations, average performance on each problem increases with age.
2. Mean performance in most of the cases favour boys rather than girls, however, they try hard to equalise their performance as they move into higher grades.
3. A given problem is solved successfully (or failed) over a wide I.Q. range both within and across the various grades.
4. The complex problem solving processes arise from simple thinking processes.
5. The adolescent pupils are affected by the content of the problem than the nature of the problem (contrary to Piaget's view).
6. Adolescent pupils are in a position to set up hypotheses, but they are not in a position, contrary to Piaget to test them. This shows that their minds have not yet become experimental.
7. The top group differed from the bottom group on all the five measures of adjustment, understanding of the problem and all the seventeen schemes of thought.

Blake, Lawson and Nordland (1979) in the 'Karplus Islands Puzzle' manipulative as well as written tasks were used. Results showed that higher inter-correlations among the Islands puzzle questions than among the three Piagetian tasks. This showed that the three Islands puzzle questions shown acceptable internal consistency while the significant correlations among Islands puzzle measures and Piagetian measures are indication of moderate relationship.

Walker, Hendix and Mistens (1979) conducted a study on 'Written Piagetian Task Instrument' using six tasks based on proportional reasoning, combinations and hypoductive logic was administered 96 students at the age of 15 years. Pre-test results indicated that 62 were at formal level and 24 were either at concrete or post concrete level. Following a three weeks interval post-test indicated 19% increase in the number of formal level students.

Lawson and Shepherd (1979) in 'Syntactical Complexity' in written language and cognitive development at formal level, found that cognitive maturity especially the development of formal reasoning is related to written language maturity.

Raizada (1979) in her study of relationship between problem solving ability and some relative personality traits using Piagetian type tasks found

the significant correlations between the grades and scores of all types of Piagetian tasks except those relating to classification and grouping of thought. She also observed that intelligence correlated significantly with all the types of Piagetian tasks. Girls exceeded boys on all tasks except on ratio and proportion.

Blake (1980) investigated the predictive power of science test and written Piagetian test and also observed the relationship between these two. The results showed that the strength of relationship between performance on understanding in science test and performance on the tasks was reduced only by the influence of reading ability in younger students. Understanding in science test is a better predictor of Piagetian level and development in higher grades than in younger.

Sandhu (1980) in a doctoral study, on the "Factorial study of Adolescent Thought" investigated the thinking processes of adolescents (N=986) of rural area between the age group 11⁺ to 15⁺ using 10 Piaget type written tasks with 24 other variables and found:

1. The performance on Piaget type tasks increases with age during the formal operational period and boys fair better than girls at the respective age levels.

2. Intelligence and academic achievement have direct bearing on adolescent thought.
3. The development of formal thinking leads to better adjustment of the individual and vice-versa.
4. Eight significant factors were extracted through factor analysis of the data. These factors had accounted for 49% of the total variance operating among all the 34 variables taken for the study. The factors extracted were named as *General intellectual factor, Academic achievement, Adjustment, Behavioural factor, Emotional factor, Temperamental factor, Group factor of adolescent thought and Social factor.

Mathur (1981) investigated the 'Growth of Experimental Mind During Adolescence' on a sample of 120 pupils studying in grade VI to XI ranging in age between 11+ to 16+, she found that the performance on Piaget type tasks show an increasing trend in grade with occasional fluctuations on certain tasks. It was found that the capacity to grasp the essence of the problem increased with grade.

Padmini (1982) studied the Growth of Exclusion of Variables During Adolescence and found that the mean performance on stating of hypotheses increases with grade and indirectly with chronological age. She observed sex differences with occasional fluctuations

exist, favouring girls. Majority of the adolescent pupils were attracted more by the content rather than the form of the problem in her study. Four factors were extracted through factor analysis of the data, namely: Stating of hypotheses, testing of hypotheses, permutations and combinations, and problem sensitivity.

Mathur (1983) in a study of Logical Thinking Among certain Groups of Adolescents on a sample of 160 pupils studying in grades VI to X ranging in between 11⁺ to 15⁺ respectively. She found the increase in the performance of Piaget type tasks and I.Q. with grades. No significant sex difference was observed except in X grade on thinking process and I.Q. in her study.

Sadhna (1984) in a study of adolescent thought, observed the increase in the performance on Piaget type tasks with age in adolescent pupils and she found significant intercorrelations between all seven schemes of thought of adolescents. Two significant factors were extracted, namely : Stating of hypotheses and I.Q. in her study.

CONCLUSIONS OF THE FINDINGS

From the various research studies, which are directly or indirectly related with this problem presented on the preceding pages of the review, the following tentative statements can safely be made.

1. The concrete-operational stage is quite dominant among normal adolescent pupils. Most of the children even upto the age of 20 years do not reach to the formal stage.
2. Adolescent's success on problems increases with chronological age and grade.
3. Most of the students studies showed no sex differences in the development of formal thought, but few observed the domination of females in urban areas, and of male in rural areas.
4. Significant relationships are found to exists between sixteen binary operations.
5. The beginning of formal thought is at possibly 13 or 14 years of age.
6. The significant relationship of academic achievements in Science subjects with level of intellectual development observed.
7. Majority of the adolescent pupils are attracted by content rather than the type of the problem.
8. There is possibility of a fifth stage called

problem finding stage beyond 16⁺ years.

DISTINCT FEATURES OF THE PRESENT STUDY

The distinct features of the present study are enlisted below :

1. It attempts to study the combinatorial reasoning using sixteen binary operations during adolescence.
2. The sample has been drawn randomly, from among equal numbers of boys and girls.
3. A number of outside variables have been included with a view to investigate the phenomena in depth.
4. The sixteen binary operations included in this study has a continuous chain of reasoning and thinking.
5. This study is conducted in urban area of Ajmer city.
6. It attempts to study the relationship between combinatorial reasoning of sixteen binary operations during adolescence and achievement.

CHAPTER III

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CHAPTER III

PLAN AND PROCEDURE OF THE STUDY

INTRODUCTION

In order to make the present study yield fruitful results, the investigator consulted all the available literature, given in Chapter II. A familiarity with literature in any problem area helps the students to discover what is already known, what others have promising or disappointing and what problems remain to be solved.

The decision about the method to be employed depends upon the nature of the problem and the kinds of data necessary for its analysis and solution. The success of any research is dependent upon the selection of appropriate method and the tools for study of the problem. The method selected, the tools and statistics employed for the problem under investigation have been dealt systematically in the chapter.

Plan and procedure of the study was framed on the basis of available relevant literature and the psychological theories. The selection of the sample, objectives, hypotheses, data gathering instruments, methods of administration, statistical treatment of data and scoring of the tests etc. are described in this chapter.

The basic idea of this study is to see the effect of sex on sixteen binary operations and on achievement in different subjects like English, Hindi, Maths, Science and Social Science. This study included 24 variables. The variables with their code are given below :

Table 1

(Twenty Four variables with their codes)

| S.No. of Variables | Name of variables | Code |
|--------------------------|----------------------------------------|----------------|
| 1. | Sex(Boys) (Girls) | 5(B) (G) |
| 2. | Achievement | Ac |
| 3. | Achievement in English | E |
| 4. | Achievement in Hindi | H |
| 5. | Achievement in Maths | M |
| 6. | Achievement in Science | S |
| 7. | Achievement in Social Science | SS |
| 8. | Raju and I robbed the bank together | I ₁ |
| 9. | I robbed the bank on my own | I ₂ |
| 10. | I am certain Raju did not rob the bank | I ₃ |

| S.No. of Variables | Name of variables | Code |
|--------------------------|----------------------------------------------------------------------------|-----------------|
| 11. | I robbed the bank but I am not saying whether Raju robbed the bank with me | I ₄ |
| 12 | At least one of us robbed the bank | I ₅ |
| 13 | I certainly did not rob the bank | I ₆ |
| 14 | I am sure that Raju robbed the bank | I ₇ |
| 15 | We could not have robbed the bank together | I ₈ |
| 16. | Neither of us robbed the bank | I ₉ |
| 17. | Only one of us robbed the bank | I ₁₀ |
| 18. | Raju robbed the bank of his own | I ₁₁ |
| 19. | If we did rob the bank, we did it together | I ₁₂ |
| 20. | If Raju did not rob the bank, I robbed it | I ₁₃ |
| 21. | If I robbed the bank, Raju robbed the bank | I ₁₄ |
| 22 | If I did not rob the bank, Raju did not rob it. | I ₁₅ |
| 23. | If I did rob the bank, Raju did not rob it. | I ₁₆ |
| 24 | Total Adolescent thought | I _T |

OBJECTIVES OF THE STUDY

The objectives of the present study are as follows :

- (1) To investigate the effect of sex on the performance of fifteen binary operations, achievement in different subjects and total adolescent thought.

- (2) To determine the effect of sex on Hindi, English, Science, Maths and Social science and total achievement.
- (3) To point out the main educational implications arising out of the present study.
- (4) To find out the relationship between combinatorial reasoning (logical thinking) and achievement in English, Hindi, Maths, Science and Social Science.

HYPOTHESES

- (1) There is no sex-wise significant difference on the scores of fifteen binary operations and total adolescent thought, as well as for the combined groups.
- (2) There is no significant co-rrrelation between fifteen binary operations and total achievement in English, Hindi, Maths, Science and Social Science of total sample.
- (3) There is a hierarchy among the fifteen binary operations of propositional logic such that certain operations are prerequisite to subsequent operations.

DELIMITATIONS OF THE STUDY

Due to paucity of time and resources, the present study was delimited with regard to area, method and sample, the delimitations are as follows :

- (1) The study was limited only total sample of 200 students (100 boys and 100 girls) drawn randomly from English medium Higher Secondary schools.
- (2) The study was confined to English medium school of Ajmer city.
 - (i) Mayo College (Boys)
 - (ii) St. Anselm's Hr. Sec. School (Boys)
 - (iii) Sophia Girls Hr. Sec. School (Girls)
 - (iv) St. Mary's Hr. Sec. school (Girls)
 - (v) DMS (Boys and Girls)
- (3) In all, the 25 girls and 25 boys were taken from each age levels.
- (4) The present study was limited to the 16 binary operations (I_1 i.e. first operation is taken as an example) which are based on Combinatorial reasoning (logical thinking).
- (5) As regards the statistical treatment of data, the mean, SD, t- test and correlation were computed.
- (6) The data on 24 variables relating to this study were obtained.

CRITERIA FOR SELECTION OF THE INSTITUTION AND SAMPLE

The first step was selection of the institution, while selecting the institutions, the researcher

adopted the following criteria:

- (1) Higher-Secondary schools having English medium of Ajmer City were selected for the present study, for the sake of convenience.
- (2) The following institutions of Ajmer city were selected randomly for the present study-

- (i) Mayo College, Ajmer
- (ii) St. Anselm's Hr. Sec. school, Ajmer
- (iii) Sophia Girls Hr. Sec. school, Ajmer
- (iv) St. Mary's Hr. Sec. school, Ajmer
- (v) D.M.S., Ajmer.

SAMPLE

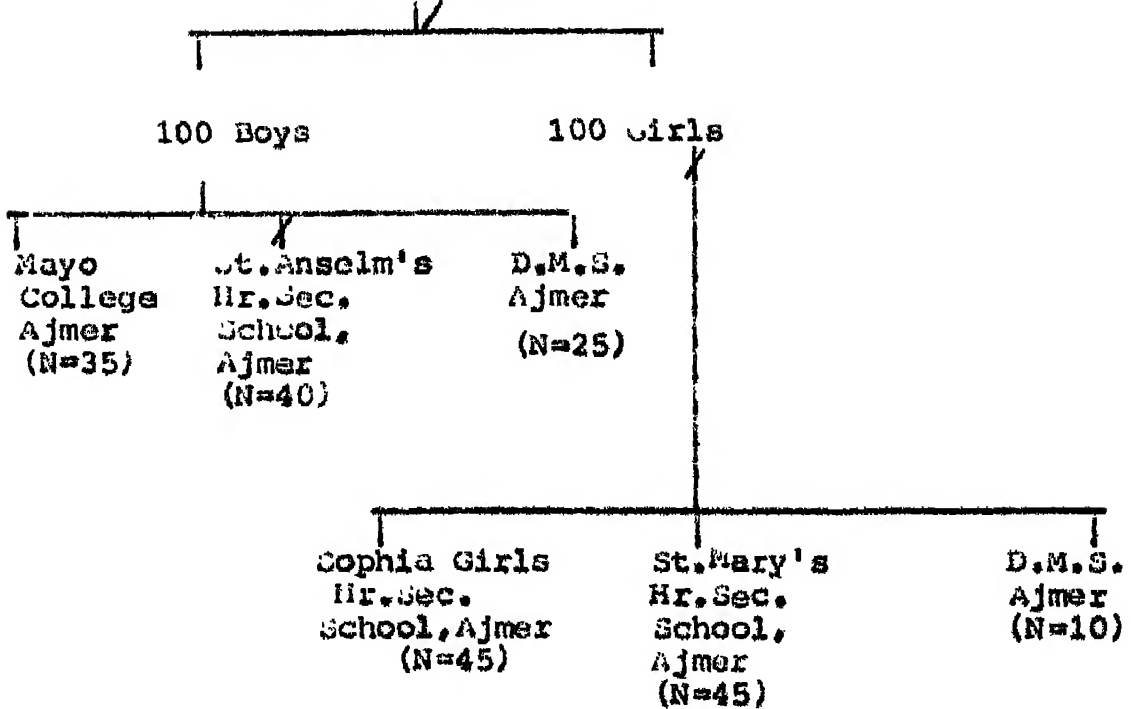
Initially a sample of 300 students was drawn randomly from five English Medium schools taking 150 boys and 150 girls, respectively studying in class XI.

The final sample was drawn comprised 200 students (100 boys and 100 girls), who appeared in the tests. Frame of the final sample is as given below:

Sample

N=200

XI Class Pupils



BINARY OPERATIONS OF INTERPROPOSITIONAL LOGIC

Organisation of thought to include possibilities relies upon a hypothetico-deductive structure requiring a more advanced form of syllogistic reasoning. Both concrete and formal operations may be characterized in terms of logico-mathematical structures of interpropositional operations. The Concrete Operational child is able to observe and identify a number of associations between objects and the occurrence or non-occurrence of these same objects or events. Confined to interpreting empirical data, he may classify four associations. In the situation where p represents a proposition, \bar{p} its

negative, q another proposition, and \bar{q} its negative, the concrete operational child is able to form four multiplicative groupings (1) p, q (2) p, \bar{q} (3) \bar{p}, q , and (4) \bar{p}, \bar{q} . These statements of occurrence and non-occurrence represent the following :

- (1) p, q , situation A occurs with B present;
- (2) p, \bar{q} , situation A occurs with B absent;
- (3) \bar{p}, q , situation A need not always occur with B present; and
- (4) \bar{p}, \bar{q} , situation A may also not occur when B is absent.

Adolescent or Formal Operational reasoning extends beyond these four multiplicative groupings through the inclusion of hypothetical assertions involving combinatorial operations. Allowing the letters a, b, c and d to represent the four original associations, sixteen possible combinations emerge (Table 2)

Table -2

Piagetian Lattice or the Sixteen Binary Propositions

| | | |
|----|-------|----------------------------------|
| 1. | a | i.e., (p, q) |
| 2. | b | i.e., (p, \bar{q}) |
| 3. | c | i.e., (\bar{p}, q) |
| 4. | d | i.e., (\bar{p}, \bar{q}) |
| 5. | $a+b$ | i.e., $(p, q) \vee (p, \bar{q})$ |
| 6. | $a+c$ | i.e., $(p, q) \vee (\bar{p}, q)$ |

| | | |
|-----|---------|------------------------------------------------------------------------|
| 7. | a+d | i.e., $(p.q) \vee (\bar{p}.\bar{q})$ |
| 8. | b+c | i.e., $(p.\bar{q}) \vee (\bar{p}.q)$ |
| 9. | b+d | i.e., $(p.\bar{q}) \vee (\bar{p}.\bar{q})$ |
| 10. | c+d | i.e., $(\bar{p}.q) \vee (\bar{p}.\bar{q})$ |
| 11. | a+b+c | i.e., $(p.q) \vee (p.\bar{q}) \vee (\bar{p}.q)$ |
| 12. | a+b+d | i.e., $(p.q) \vee (p.\bar{q}) \vee (\bar{p}.\bar{q})$ |
| 13. | a+c+d | i.e., $(p.q) \vee (\bar{p}.q) \vee (\bar{p}.\bar{q})$ |
| 14. | b+c+d | i.e., $(p.\bar{q}) \vee (\bar{p}.q) \vee (\bar{p}.\bar{q})$ |
| 15. | a+b+c+d | i.e., $(p.q) \vee (p.\bar{q}) \vee (\bar{p}.q) \vee (\bar{p}.\bar{q})$ |
| 16. | o | i.e., $(p.q) \vee (p.\bar{q}) \vee (\bar{p}.q) \vee (\bar{p}.\bar{q})$ |

DECENTRATION AND RECIPROCITY

The combinatorial system of the propositional relations and the reversibilities of the INRC Grouping constitute the structure of formal operational thought. This integration of cognitive skills reaches its equilibrium at about age 15. By this time the adolescent has superimposed propositional logic onto the logic of concrete classifications and has incorporated a number of operational schemata, the INRC transformations.

The outstanding characteristic of the pre-formal Operational child is the tendency to center, that is, to focus upon a single feature of an object or event to the exclusion of other significant factors. Confined to this phenomenal interpretation of reality, the child is given to subjective distortions of reasoning.

Table 3

Interpropositional Operations As a Group (INRC)

- | | |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.Identity (I) | This 'null' transformation changes nothing in the proposition on which it is performed. |
| 2.Negation (N) | This transformation changes everything in the proposition on which it bears. That is, all assertions become negations, and all conjunctions become disjunctions, and vice versa. |
| 3.Reciprocal (R) | This transformation permittes assertions and negations but levels conjunctions and disjunctions unchanged. |
| 4.Correlative (C) | This transformation permutes conjunctions and disjunctions but leaves assertions and negations unchanged. |

ACADEMIC ACHIEVEMENT

The term academic achievement is synonymous of scholastic achievement. In the present study scholastic achievement is the scores obtained by the students in their final examination of previous year.

The marks obtained by the students in their final examination of previous year were taken from their school record, as the measure of their scholastic

achievement or academic achievement.

ADMINISTRATION AND SCORING OF THE TEST

This test was administered in a group of students at a time in each class. It took about 30 minutes in completing the test. First the students were explained the procedure of answering the problems using item first (I_1) as an example. The students were asked to write the answer of each item in the space provided below each item. Each item has minimum score zero and maximum score one. Partially correct answers were considered as wrong answers and scored zero.

Table 4

Weightage for the items

| Item No. | Statement | Marks for each correct item |
|----------|----------------------------------------------------------------------------|-----------------------------|
| I_1 | Raju and I robbed the bank together | Taken as an example |
| I_2 | I robbed the bank on my own | 1 |
| I_3 | I am certain Raju did not rob the bank | 1 |
| I_4 | I robbed the bank but I am not saying whether Raju robbed the bank with me | 1 |
| I_5 | At least one of us robbed the bank | 1 |
| I_6 | I certainly did not rob the bank | 1 |
| I_7 | I am sure that Raju robbed the bank | 1 |
| I_8 | We could not have robbed the bank together | 1 |

| Item No. | Statement | Marks for each item |
|-------------------------------|------------------------------------------------|---------------------|
| I ₉ | Neither of us robbed the bank | 1 |
| I ₁₀ | Only one of us robbed the bank | 1 |
| I ₁₁ | Raju robbed the bank of his own | 1 |
| I ₁₂ | If we did rob the bank, we did it together | 1 |
| I ₁₃ | If Raju did not rob the bank, I robbed it | 1 |
| I ₁₄ | If I robbed the bank, Raju robbed the bank | 1 |
| I ₁₅ | If I did not rob the bank, Raju did not rob it | 1 |
| I ₁₆ | If I did rob the bank, Raju did not rob it | 1 |
| Total weightage for all items | | 15 |

STATISTICAL TECHNIQUES USED

The statistical techniques used in the analysis of the data are given below :

- (i) Descriptive statistics like mean and standard deviation were calculated.
- (ii) The 't' test was employed to find out the significance of difference between means related to different sub groups of the variables.
- (iii) Scatter-diagram, method of correlation was used for determining the relationship among the variables.

TABLE 5

Scores of Grade XI Science-Boys and Girls in descending order.

| S. No. | Sex | Fifteen Binary Operations | | | | | | | | | | | | | | | Total |
|--------|-----|---------------------------|--------|--------|---------|---------|---------|---------|--------|---------|--------|--------|---------|--------|--------|--------|-------|
| | | I 16 | I 5 | I 8 | I 14 | I 12 | I 10 | I 13 | I 6 | I 15 | I 4 | I 3 | I 11 | I 7 | I 9 | I 2 | |
| 1 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 05 |
| 2. | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 04 |
| 2 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 05 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 04 |
| 3 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 05 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 05 |
| 4 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 05 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 05 |
| 5 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 06 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 05 |
| 6. | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 06 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 05 |
| 7. | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 06 |
| | G | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 05 |
| 8 | B | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 06 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 05 |
| 9 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 06 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 05 |
| 10 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 06 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 06 |
| 11 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 06 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 06 |
| 12 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 06 |

| S. No. | Sex | Fifteen Binary Operations | | | | | | | | | | | | | | | Total |
|--------|-----|---------------------------|---|---|----|----|----|----|---|----|---|---|----|---|---|---|-------|
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | | 16 | 5 | 8 | 14 | 12 | 10 | 13 | 6 | 15 | 4 | 3 | 11 | 7 | 9 | 2 | |
| 13 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 06 |
| 14 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 06 |
| 15 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 06 |
| 16 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 06 |
| 17 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 06 |
| 18 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 06 |
| 19 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 06 |
| 20 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 06 |
| 21 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 06 |
| 22 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 06 |
| 23 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| | G | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 07 |
| 24 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 07 |

| S. No. | Sex | Fifteen Binary Operations | | | | | | | | | | | | | | | Total |
|--------|-----|---------------------------|-----|-----|------|------|------|------|-----|------|-----|-----|------|-----|-----|-----|-------|
| | | I 16 | I 5 | I 8 | I 14 | I 12 | I 10 | I 13 | I 6 | I 15 | I 4 | I 3 | I 11 | I 7 | I 9 | I 2 | |
| 25 | B | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 07 |
| 26 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 07 |
| 27 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| 28 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 07 |
| 29 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| 30 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 07 |
| 31 | B | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 07 |
| 32 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 07 |
| 33 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 34 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 08 |
| 35 | B | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 36 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |

| S. No. | Sex | Fifteen Binary Operations | | | | | | | | | | | | | | | Total |
|--------|-----|---------------------------|--------|--------|---------|---------|---------|---------|--------|---------|--------|--------|---------|--------|--------|--------|-------|
| | | 1 16 | 1 5 | 1 8 | 1 14 | 1 12 | 1 10 | 1 13 | 1 6 | 1 15 | 1 4 | 1 3 | 1 11 | 1 7 | 1 9 | 1 2 | |
| 37 | B | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 08 |
| 38 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 08 |
| 39 | B | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 40 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 41 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| | G | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 08 |
| 42 | B | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 19 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 43 | B | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 44 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 45 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 08 |
| 46 | B | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 08 |
| 47 | B | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 08 |
| 48 | B | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |

| S. No. | Sex | Fifteen Binary Operations | | | | | | | | | | | | | | | Total |
|--------|-----|---------------------------|---|---|----|----|----|----|---|----|---|---|----|---|---|---|-------|
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | | 16 | 5 | 8 | 14 | 12 | 10 | 13 | 6 | 15 | 4 | 3 | 11 | 7 | 9 | 2 | |
| 49 | B | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 08 |
| 50 | B | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 08 |
| 51 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 08 |
| 52 | B | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 08 |
| 53 | B | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 54 | B | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 09 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 55 | B | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| | G | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 56 | B | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 09 |
| | G | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 57 | B | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 58 | B | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 59 | B | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 60 | B | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 09 |

| S. No. | Sex | Fifteen Binary Operations | | | | | | | | | | | | | | | Total |
|--------|-----|---------------------------|--------|--------|---------|---------|---------|---------|--------|---------|--------|--------|---------|--------|--------|--------|-------|
| | | I 16 | I 5 | I 8 | I 14 | I 12 | I 10 | I 13 | I 6 | I 15 | I 4 | I 3 | I 11 | I 7 | I 9 | I 2 | |
| 61 | B | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 62 | B | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 63 | B | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 64 | B | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 65 | B | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 66 | B | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 09 |
| 67 | B | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 10 |
| | G | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 09 |
| 68 | B | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 09 |
| 69 | B | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 10 |
| | G | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 09 |
| 70 | B | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| 71 | B | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| 72 | B | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| | G | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 10 |

[illegible]

[illegible]

| S. No. | Sex | Fifteen Binary Operations | | | | | | | | | | | | | | Total |
|--------|-----|---------------------------|---|---|----|----|----|----|---|----|---|---|----|---|---|-------|
| | | 16 | 5 | 8 | 14 | 12 | 10 | 13 | 6 | 15 | 4 | 3 | 11 | 7 | 9 | 2 |
| 97 | B | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 14 |
| | G | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| 98 | B | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 14 |
| | G | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| 99 | B | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 14 |
| | G | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
| 100 | B | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 14 |
| | G | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 13 |

IV

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PRESENTATION, ANALYSIS AND
INTERPRETATION OF DATA

CHAPTER IV

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA.

INTRODUCTION

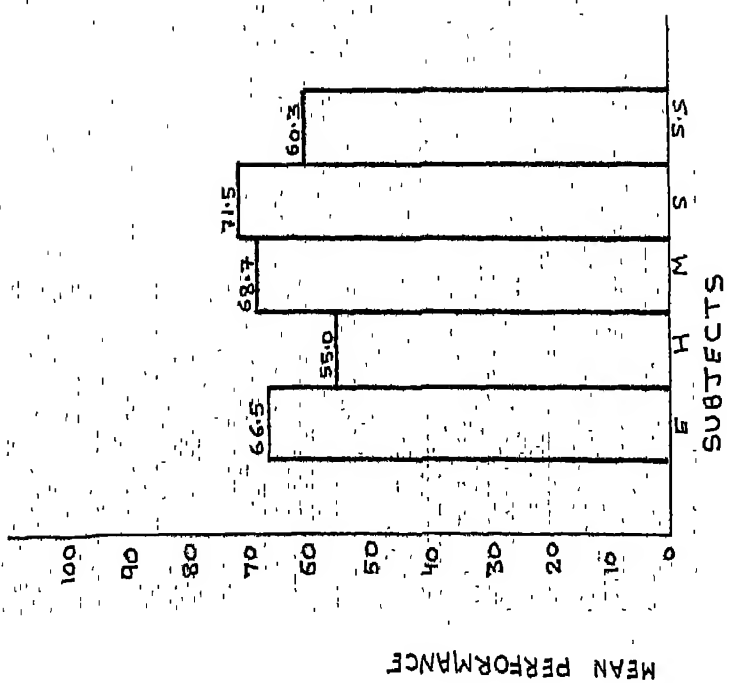
The administration and scoring of test was done according to procedure which is described in previous chapter. The data have been taken from five schools, Mayo College, St. Anselm's Hr. Sec. school, Sophia Girls Hr. Sec. school, St. Mary's Hr. Sec. school, D.M.S. Ajmer. The data were collected in respect of 200 students (100 boys and 100 girls) on fifteen binary operations alongwith academic achievement. Raw scores of all variable of each students are presented in the Appendix.

Raw scores were analysed and interpreted from different angles in order to obtain inherent facts and meaning. The binary operations based on logical thinking were scored out as mentioned in previous chapter. The scores for Academic Achievement in all subjects were collected from their respective schools register record.

GRAPH NO. 1

MEAN PERFORMANCE OF ACADEMIC ACHIEVEMENT ON TOTAL SAMPLE.

- E-English
- H-History
- M-Mathematics
- S-Science
- SS-Social Science



The results of different statistic employed in terms of mean, standard Deviation (S.D.) correlation and 't' values for all are presented in the tabular form.

Table 6

Mean and Standard Deviation for Academic achievement of Adolescents.

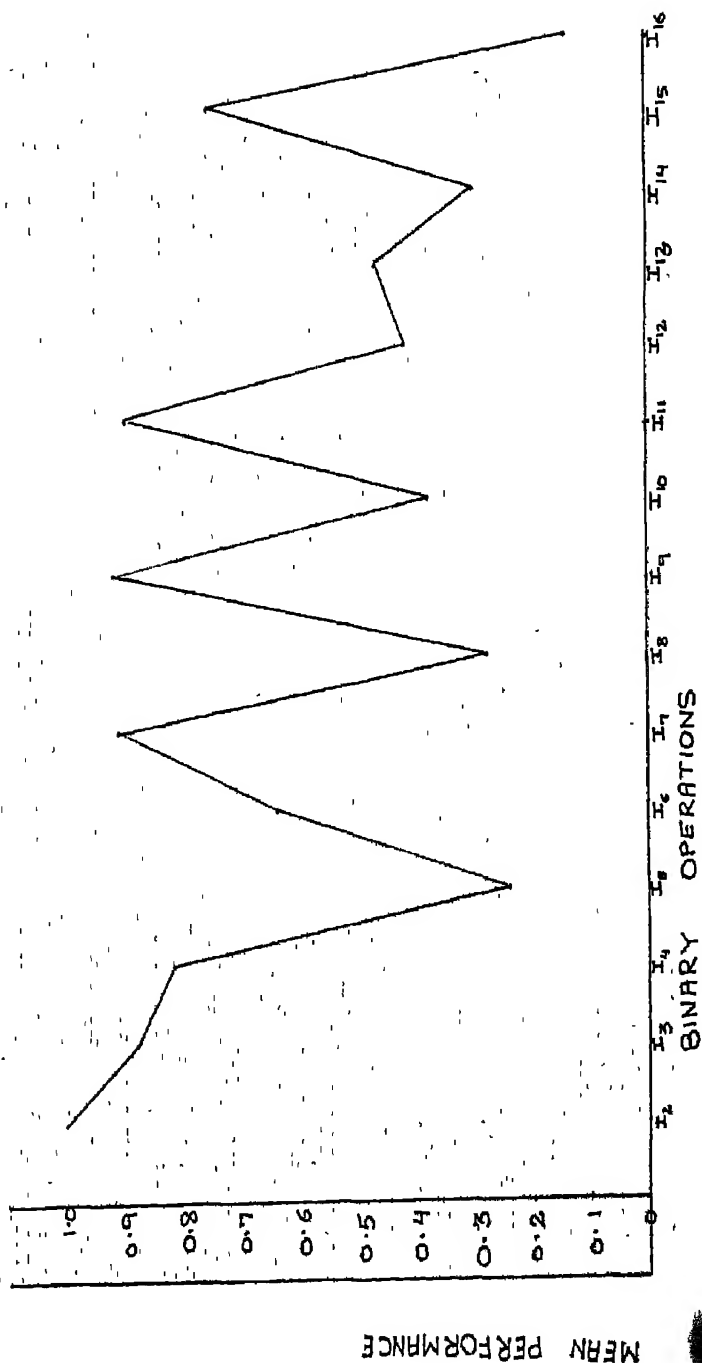
| Subjects | Mean | S.D. |
|-------------------------------|-------|-------|
| Achievement in English | 66.48 | 12.64 |
| Achievement in Hindi | 55.09 | 10.49 |
| Achievement in Maths | 68.67 | 16.33 |
| Achievement in Science | 71.55 | 10.89 |
| Achievement in Social Science | 60.35 | 13.32 |

The results presented in table 6 shows the value of mean and standard deviation (S.D.) for the measure of Academic Achievement.

The value of mean in English is 66.48 and value of S.D. was found to be 12.64

The value of mean and S.D. in the measure of achievement in Hindi was found to be 55.09 and 10.49 respectively.

MEAN PERFORMANCE OF FIFTEEN BINARY OPERATIONS*



The results of achievement in Maths showed, the value of mean 68.67 and the value of S.D. was found to be 16.33

The value of mean and S.D. in the measure of achievement in Science was found to be 71.55 and 10.89 respectively.

The value of mean and S.D. in Social science was found to be 60.35 and 13.32.

Table 7

The values of Mean and Standard Deviation for Fifteen Binary Operations and Total Adolescent Thought of the total sample.

| Binary operations | Mean | S.D. |
|-------------------|------|------|
| I ₂ | 1.00 | 0.0 |
| I ₃ | 0.88 | .23 |
| I ₄ | 0.82 | 0.32 |
| I ₅ | 0.24 | 0.41 |
| I ₆ | 0.64 | 0.48 |
| I ₇ | 0.91 | 0.26 |
| I ₈ | 0.28 | 0.39 |
| I ₉ | 0.92 | 0.22 |
| I ₁₀ | 0.38 | 0.48 |
| I ₁₁ | 0.90 | 0.22 |
| I ₁₂ | 0.42 | 0.45 |
| I ₁₃ | 0.47 | 0.46 |

| Binary operations | Mean | S.D. |
|-------------------|------|------|
| I ₁₄ | 0.30 | 0.46 |
| I ₁₅ | 0.76 | 0.39 |
| I ₁₆ | 0.14 | 0.28 |
| I _T | 9.18 | 5.07 |

Table 7 shows the value of Mean, and standard deviation for fifteen binary operations and total adolescent thought of the total sample.

It is evident from the statistics presented in Table-7 that, the values of mean varies between 0.14 and 1.00, being lowest in I₁₆ and highest in I₂.

The values of S.D. for the measure of adolescent thought varies from 0.00 to 0.48 being lowest in I₂ and highest in I₆ and I₁₀.

The mean and S.D. values for total adolescent thought was found to be 9.18 and 5.07 respectively.

Table 8

The values of Mean and Standard Deviation for fifteen Binary Operations and total adolescent thought at different sex levels as well as for the combined Group (N=200).

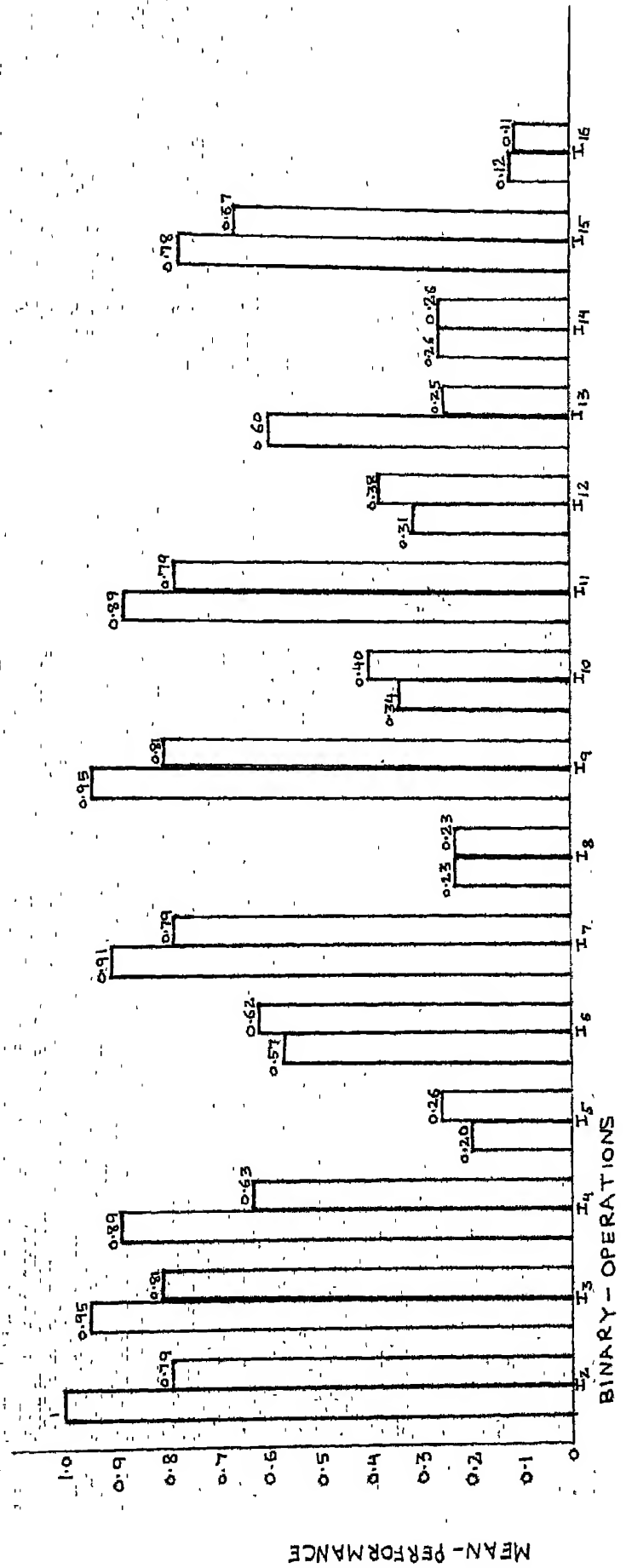
| Binary operations | Sex | Mean | Standard Deviation |
|-------------------------------------------|-----|------|--------------------|
| National Institute of Education | | | |
| Library & Documentation Unit (N.C.E.R.T.) | | | |
| I ₂ | B | 1 | 0 |
| | G | 0.79 | 0.27 |

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GRAPH NO. 3

COMPARATIVE PERFORMANCE OF BOYS AND GIRLS ON
FIFTEEN BINARY OPERATIONS.

Boys ☐
Girls ☐



| Binary operations | Sex | Mean | Standard Deviation |
|----------------------|-----|------|-----------------------|
| I ₃ | B | 0.95 | 0.10 |
| | G | 0.81 | 0.34 |
| I ₄ | B | 0.89 | 0.21 |
| | G | 0.63 | 0.44 |
| I ₅ | B | 0.20 | 0.41 |
| | G | 0.26 | 0.43 |
| I ₆ | B | 0.57 | 0.47 |
| | G | 0.62 | 0.47 |
| I ₇ | B | 0.91 | 0.29 |
| | G | 0.79 | 0.27 |
| I ₈ | B | 0.23 | 0.43 |
| | G | 0.23 | 0.38 |
| I ₉ | B | 0.95 | 0.13 |
| | G | 0.81 | 0.28 |
| I ₁₀ | B | 0.34 | 0.46 |
| | G | 0.40 | 0.48 |
| I ₁₁ | B | 0.89 | 0.20 |
| | G | 0.79 | 0.27 |
| I ₁₂ | B | 0.31 | 0.45 |
| | G | 0.38 | 0.47 |
| I ₁₃ | B | 0.60 | 0.48 |
| | G | 0.25 | 0.45 |
| I ₁₄ | B | 0.26 | 0.47 |
| | G | 0.26 | 0.42 |

| Binary operations | Sex | Mean | Standard Deviation |
|-------------------|-----|------|--------------------|
| I ₁₅ | B | 0.78 | 0.37 |
| | G | 0.67 | 0.40 |
| I ₁₆ | B | 0.12 | 0.31 |
| | G | 0.11 | 0.24 |
| I _T | B | 8.80 | 4.07 |
| | G | 7.97 | 6.47 |

Table 8 reveals that the values of mean and standard deviation for fifteen binary operations and total adolescent thought at different sex levels as well as for the combined group. The table has following characteristics. The mean performance of boys on binary operations were better than girls except for I₇, I₉, and I₁₂.

The values of standard deviation were maximum with respect to girls as compared to boys on total adolescent thought.

The mean performance of girls on total adolescent thought was found to be better than boys.

CHAPTER V

RESULTS OF STATISTICAL ANALYSIS DISCUSSION AND CONCLUSIONS

CHAPTER V

RESULTS OF STATISTICAL ANALYSIS, DISCUSSIONS AND CONCLUSIONS

INTRODUCTION

In the previous chapter the responses on the Binary operations and academic achievement has been presented. The Descriptive statistics like mean and S.D. were calculated analysed and interpreted. In the present chapter the results of inferential statistics like 't' value, correlation are presented and interpreted. In this chapter the analysis of the data in relation to the corresponding null hypothesis have been presented in the following paragraphs.

RESULTS BASED ON 't' TEST AND CORRELATION

To test the hypothesis, the data regarding the performance on binary operations and achievement were put to 't' test and correlation to determine the

significance of the differences between them. The 't' ratios, this calculated for all the fifteen binary operations, and total adolescent thought have been presented in tables, and correlation between the total adolescent thought and other variables.

FIRST NULL HYPOTHESES

There is no sexwise significant difference on the scores of fifteen binary operations and total adolescent thought, as well as for the combined groups.

The 't' values were calculated for fifteen binary operations between the boys and girls to test the first hypothesis. The results are presented in the Table No.9.

Table 9

't' ratios regarding the comparative performance of students on fifteen binary operations and total adolescent thought at different sex levels as well as for the combined group.

| Binary operations | Sex | Number of students | Mean | S.D. | 't' | Level of significance. |
|-------------------|-----|--------------------|------|-------|------|------------------------|
| I ₂ | B | 100 | 1.00 | 0.00 | 7.77 | .01 |
| | G | 100 | 0.79 | 0.027 | | |
| I ₃ | B | 100 | 0.95 | 0.10 | 4.66 | .01 |
| | G | 100 | 0.81 | 0.34 | | |
| I ₄ | B | 100 | 0.89 | 0.21 | 5.20 | .01 |
| | G | 100 | 0.63 | 0.44 | | |
| I ₅ | B | 100 | 0.20 | 0.41 | 1.00 | N.S. |
| | G | 100 | 0.26 | 0.43 | | |
| I ₆ | B | 100 | 0.57 | 0.47 | 0.71 | N.S. |
| | G | 100 | 0.62 | 0.47 | | |

| Binary operations | Sex | Number of Students | Mean | S.D. | 't' | Level of significance |
|-------------------|-----|--------------------|------|------|------|-----------------------|
| I ₇ | B | 100 | 0.91 | 0.29 | 3.00 | .01 |
| | G | 100 | 0.79 | 0.27 | | |
| I ₈ | B | 100 | 0.23 | 0.43 | 0.00 | N.S. |
| | G | 100 | 0.23 | 0.38 | | |
| I ₉ | B | 100 | 0.95 | 0.13 | 4.66 | .01 |
| | G | 100 | 0.81 | 0.28 | | |
| I ₁₀ | B | 100 | 0.34 | 0.46 | 1.00 | N.S. |
| | G | 100 | 0.40 | 0.48 | | |
| I ₁₁ | B | 100 | 0.89 | 0.20 | 3.33 | .01 |
| | G | 100 | 0.79 | 0.27 | | |
| I ₁₂ | B | 100 | 0.31 | 0.45 | 1.16 | N.S. |
| | G | 100 | 0.38 | 0.47 | | |
| I ₁₃ | B | 100 | 0.60 | 0.48 | 6.15 | .01 |
| | G | 100 | 0.25 | 0.45 | | |
| I ₁₄ | B | 100 | 0.26 | 0.47 | 0 | N.S. |
| | G | 100 | 0.26 | 0.42 | | |
| I ₁₅ | B | 100 | 0.78 | 0.37 | 2.20 | .05 |
| | G | 100 | 0.67 | 0.40 | | |
| I ₁₆ | B | 100 | 0.12 | 0.31 | 0.27 | N.S. |
| | G | 100 | 0.11 | 0.24 | | |
| I _T | B | 100 | 8.80 | 4.07 | 0.54 | N.S. |
| | G | 100 | 7.97 | 6.47 | | |

Table 9 reveals the 't' ratios regarding the comparative performance of students on fifteen binary operations and total adolescent thought at different sex levels as well as for the combined group.

1) From the mean performance of boys and girls we can safely say that in 60% cases the boys were better than girls and in 33.33 percent cases girls were better

than girls and 33.33 percent cases girls were better than boys. In 13.33 percent cases the performance of boys and girls were equal.

2) Out of 15 't' ratios $I_2, I_3, I_4, I_7, I_9, I_{11}$ and I_{14} were significant at 0.01 level, and I_{15} was significant at 0.05 level. $I_5, I_6, I_8, I_{10}, I_{12}, I_{14}$ and I_{16} were not significant at .05 and .01 level.

Thus it has been concluded that out of 15 't' ratios computed 8 't' ratios were found to be significant between the sexes on Piaget type items.

The null hypothesis first is partially rejected.

Table 10

Correlation between fifteen binary operations and academic achievement N=200

| S.No. | Correlation between Variables | Correlation coefficient | Level of significance. |
|-------|---------------------------------------------------------------------|-------------------------|------------------------|
| 1. | Total adolescent thought and achievement in English of total sample | 0.18 | 0.05 |
| 2. | Total adolescent thought and achievement in Hindi of total sample | 0.03 | N.S. |
| 3. | Total adolescent thought and achievement in Maths of total sample | 0.26 | 0.01 |
| 4. | Total adolescent thought and achievement in Science of total sample | 0.35 | 0.01 |

| S.No. | Correlation between variables | Correlation coefficient | Level of significance. |
|-------|----------------------------------------------------------------------------|-------------------------|------------------------|
| 5. | Total adolescent thought and achievement in Social Science of total sample | 0.43 | 0.01 |
| 6. | Total adolescent thought and academic achievement of total sample | 0.39 | 0.01 |

SECOND NULL HYPOTHESIS:

There is no significant correlations between fifteen binary operations and total achievement in English, Hindi, Maths, Science and Social Science of total sample.

For testing the hypothesis number fifth correlation coefficient of the scores on total adolescent thought with English, Hindi, Maths, Science and Social Science were calculated for the total sample. The results are presented in the table No.10.

The result shows that there is significant correlation between the scores on total adolescent thought and achievement in English, Maths, Science, and Social Science of total sample.

There is no significant correlation in Total adolescent thought and achievement in Hindi of total sample.

Thus, the hypothesis Second is partially rejected.

TABLE NO. 3

COMPARATIVE PERFORMANCE (IN PERCENTAGE) OF SEQUENTIAL AND DIRECT ADDRESS OPERATIONS



Table 11

Comparative performance (in percentage) of students in fifteen binary operations in descending order.

| Binary operations | Total | Percentage |
|-------------------|-------|------------|
| I ₁₆ | 18 | 9 |
| I ₅ | 42 | 21 |
| I ₈ | 43 | 21.50 |
| I ₁₄ | 56 | 28 |
| I ₁₂ | 63 | 31.50 |
| I ₁₀ | 76 | 38 |
| I ₁₃ | 90 | 45 |
| I ₆ | 132 | 66 |
| I ₁₅ | 155 | 77.50 |
| I ₄ | 164 | 82 |
| I ₃ | 177 | 88.50 |
| I ₁₁ | 180 | 90 |
| I ₇ | 183 | 91.50 |
| I ₉ | 186 | 93 |
| I ₂ | 199 | 99.50 |

THIRD NULL HYPOTHESES

There is a hierarchy among the fifteen binary operations of propositional logic such that certain operations are prerequisite to subsequent operations.

Table 11 reveals the comparative performance

(in percentage) of students on fifteen binary operations in descending order.

Only two items at S.Nos. T_{16} and T_5 have proved to be too difficult for the XI grade pupils.

By seeing the percentage obtained for each operation it can safely be said that these operations (from I_2 to I_{16}) are not found to be in a logical order. Maximum percentage was obtained for operation I_2 , this may due to -

- (i) some hints may be given in the question,
- (ii) It's language is easy to understand. Minimum percentage was obtained for operation I_{16} this may be due to :
 - (i) Hints may not be given in the question
 - (ii) It's language is difficult to understand.

By seeing these two operations it can be concluded that there is a hierarchy among the fifteen binary operations. But for other binary operations such a hierarchy was not found.

The most visually outstanding pattern in all is that the single set propositions appear logically prerequisite to the double set operations, and further, the double set operations appear as prerequisites to the triple set operations.

Thus, the hypothesis third is not retained.

INTERPRETATION AND DISCUSSION

The aim of this chapter is at exploring the relationship of combinatorial reasoning with the variables of sex and achievement.

The sex difference in the performance of fifteen binary operations showed that the performance of boys were better than girls, as well as for the combined group.

The performance of boys for combinatorial reasoning is much better than the girls for all age levels as well as for the combined group. It can safely be concluded that combination power is much better in boys than the girls.

There was significant correlation (0.01) of total adolescent thought with Maths, Science, Social-Science and with overall academic achievement of the total sample. The correlation of total adolescent thought with English was found to be significant at (0.05) level. It can be concluded that Hindi as a discipline is not helpful in the development of combination reasoning. The linguistic ability like Hindi and English are not or less correlated with

combination reasoning. English is correlated only at .05 level and Hindi is not correlated at all while other subjects like Maths, science and Social science are significantly correlated with combination reasoning. It can be interpreted that linguistic abilities are not helpful in the development of combination reasoning. The achievement has also shown the significant correlation (0.01) with the total adolescent thought.

The performance on achievement of boys were better than girls.

The most visually outstanding point is that the single-set propositions appear logically prerequisite to the double-set operations, and further, the double set operations appear as pre-requisites to the triple-set operations.

CHAPTER VI

SUMMARY,
AND
FOR

EDUCATIONAL IMPLICATIONS
PROBLEMS
FURTHER RESEARCH.

CHAPTER VI

SUMMARY, EDUCATIONAL IMPLICATION AND PROBLEMS FOR FURTHER RESEARCH.

INTRODUCTION

In the past twenty years, man has brought about a revolution in almost every sphere of existence, by means of new materials, technology and concepts. At the same time philosophers, and psychologists have tried to study and explain human behaviour and human mind. The scientific investigation of thinking processes is gaining importance as the growth of highly logical mind has become the most important goal of the psychology in the developing society. Unlike it, the essence of technology is the designing of new and novel products.

The late Prof. Jean Piaget (1896-1980) had contributed extensively in the field of psychology and to the models of human thinking. Piaget's model suggests qualitative differences in thinking for

each developmental stage. (The basic concepts of stage theory is the notion of sequential change rather than age specification) Piaget has grouped these qualitative changes in thinking into four stages of development. These are : Sensory Motor (birth to 2 years), Pre-operational (2 to 7 years), Concrete Operational (7 to 11 years), and Formal Operational (11 to 15 years). Recently he has hinted at the possibility of the fifth stage, which covers the period from 15 to 20 years. The first is of little educational significance, but at the same time, is at the bottom of all the succeeding stages. In the second stage, the thinking or reasoning is transductive, that is, from particular to particular. At the third stage, reality dominates thinking which is reversed at the fourth stage. Here, the adolescent pupil can set up all sorts of hypotheses, test in varied contexts and various elements of scientific methods. Piaget believes that the adolescent mind can be described as a logical computing machine that manipulates abstract structures. He argues that logical structures make up the ideal patterns for all living system. Development of logical thinking among adolescence is more important to help them to abstracting, analyzing, generalizing, comparing, defining, estimating, understanding etc.

The purpose of the present study is to investigate the growth of combinatorial reasoning of science adolescent pupils through sixteen binary operations and its relationship with the variables of sex and achievement.

OBJECTIVES OF THE STUDY

The objectives of the present study are as follows :

- (1) To investigate the effect of sex on the performance of fifteen binary operations (first operation is taken as an example), achievement in different subjects and total adolescent thought.
- (2) To point out the main educational implications arising out of the present study.
- (3) To determine the effect of sex on Hindi, English, Science, Maths and Social Science and Total achievement.
- (4) To find out the relationship between combinatorial reasoning and achievement in English, Hindi, Maths, Science and Social science.

HYPOTHESES

- (1) There is no sex-wise significant difference on the scores of fifteen binary operations and total adolescent thought, as well as for

the combined groups.

- (2) There is no significant correlation between fifteen binary operations and total achievement in English, Hindi, Maths, Science and Social-Science of total sample.
- (3) There is a hierarchy among the fifteen binary operations of propositional logic such that certain operations are prerequisite to subsequent operations.

SELECTION OF THE SAMPLE

Initially a sample of about 300 students (150 boys and 150 girls) was drawn randomly from the students of five higher secondary English medium schools, studying in grade XI.

TOOLS USED

A combinatorial reasoning using sixteen binary operations during adolescence is selected in the present study. The frame of the test is given below :

| S.No. | Statement |
|-------|-----------------------------------------------------------------------------|
| 1. | Raju and I robbed the bank together. |
| 2. | I robbed the bank on my own. |
| 3. | I am certain Raju did not rob the bank |
| 4. | I robbed the bank but I am not saying whether Raju robbed the bank with me. |

| S.No. | Statement |
|-------|-------------------------------------------------|
| 5 | at least one of us robbed the bank. |
| 6 | I certainly did not rob the bank. |
| 7 | I am sure that Raju robbed the bank. |
| 8 | We could not have robbed the bank together. |
| 9 | Neither of us robbed the bank. |
| 10. | Only one of us robbed the bank. |
| 11. | Raju robbed the bank of his own. |
| 12. | If we did rob the bank, we did it together. |
| 13. | If Raju did not rob the bank,I robbed it. |
| 14. | If I robbed the bank, Raju robbed the bank. |
| 15. | If I did not rob the bank, Raju did not rob it. |
| 16. | If I did rob the bank, Raju did not rob it. |

STATISTICAL TREATMENT OF DATA

The statistical techniques used in the analysis of data are given below :

1. The value of mean and standard deviation were determined for all the variables.
2. The 't' was employed to find out the significance of difference between mean related to different sub-groups of the variables.
3. Scatter-diagram method of correlation was used for determining the relationship among the variables.

MAJOR FINDINGS

The investigator has arrived at the following-

- (1) The sex difference in the comparative performance of boys and girls on total adolescent thought as well as for the combined groups was found to be different. The performance of boys were better than the girls.
- (2) The comparative performance of Achievement is favouring boys in comparison to girls.
- (3) The coefficient of correlation between measures of achievement with total adolescent thought was found to be significant at 0.01 level. Thus it can be concluded that as achievement increases adolescent thought also increases.
- (4) The boys are better than girls in combinatorial reasoning (logical thinking).
- (5) The single set propositions appear logically prerequisite to the double set operations, and further, the double set operations appear as prerequisites to the triple set operations.

EDUCATIONAL IMPLICATIONS AND FURTHER RESEARCH

The educational implications arising out of Piaget's work are yet at the conjectural stage within the context of this study, it can be safely said

that children should be trained in carrying out the processes of thought rather than products of thought and that too gradually.

Before this happens, it is also necessary to determine the incidence of formal thought during adolescence among different populations of school going students using the four card problem once this is done, it is more difficult to study this variable in its widest variation in relation to other outside variables like intelligence, personality traits socio-economic status and other school subjects.

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"Billu And Raju" Answer Sheet

Name :

Age -

| Statement | Card No. | Symbolic description of correct Cards |
|--------------------------------------------------------------------------------|----------|---------------------------------------|
| 1. Raju and I robbed the bank together. | | |
| 2. I robbed the bank on my own. | | |
| 3. I am certain Raju did not rob the bank. | | |
| 4. I robbed the bank but I am not saying whether Raju robbed the bank with me. | | |
| 5. At least one of us robbed the bank. | | |
| 6. I certainly did not rob the bank. | | |
| 7. I am sure that Raju robbed the bank. | | |
| 8. We could not have robbed the bank together. | | |
| 9. Neither of us robbed the bank. | | |
| 10. Only one of us robbed the bank. | | |
| 11. Raju robbed the bank of his own. | | |
| 12. If we did rob the bank, we did it together. | | |
| 13. If Raju did not rob the bank, I robbed it. | | |
| 14. If I robbed the bank, Raju robbed the bank. | | |
| 15. If I did not rob the bank, Raju did not rob it. | | |
| 16. If I did rob the bank, Raju did not rob it. | | |

Billu



Yes, I did rob the bank

Raju

CARD I



Yes, I did rob the bank

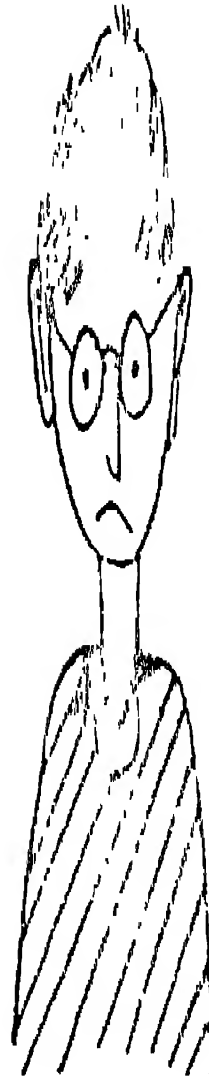
Billu



Yes, I did rob the bank

Raju

CARD II



No, I did not rob the bank

Billu



No, I did not rob the bank

Raju

CARD II



Yes, I did rob the bank

Billu.



No, I did not rob the bank

Raju

CARD IV



No, I did not rob the bank

APPENDIX I

Scores of Grade XI Science Boys

| S.No. | Academic Achievement | | | | | Total Achieve- ment |
|-------|----------------------|-------|-------|---------|-------------------|---------------------------|
| | English | Hindi | Maths | Science | Social Science | |
| 1. | 66 | 54 | 72 | 82 | 75 | 349 |
| 2 | 58 | 37 | 85 | 80 | 67 | 327 |
| 3 | 69 | 35 | 68 | 73 | 75 | 320 |
| 4 | 60 | 68 | 82 | 87 | 69 | 366 |
| 5 | 55 | 42 | 93 | 75 | 61 | 326 |
| 6 | 74 | 46 | 78 | 82 | 71 | 351 |
| 7 | 65 | 59 | 54 | 80 | 66 | 324 |
| 8 | 64 | 58 | 69 | 77 | 68 | 336 |
| 9 | 75 | 60 | 68 | 79 | 79 | 361 |
| 10 | 58 | 52 | 73 | 81 | 60 | 324 |
| 11 | 63 | 76 | 73 | 85 | 63 | 360 |
| 12 | 56 | 42 | 65 | 70 | 63 | 296 |
| 13 | 67 | 33 | 73 | 73 | 67 | 313 |
| 14 | 69 | 49 | 64 | 77 | 70 | 329 |
| 15 | 57 | 63 | 56 | 56 | 68 | 300 |
| 16 | 73 | 47 | 79 | 82 | 78 | 359 |
| 17 | 54 | 37 | 92 | 71 | 55 | 309 |
| 18 | 53 | 38 | 91 | 90 | 74 | 346 |
| 19 | 75 | 70 | 81 | 88 | 61 | 375 |
| 20 | 60 | 33 | 81 | 78 | 60 | 312 |
| 21 | 69 | 57 | 97 | 86 | 77 | 387 |
| 22 | 71 | 56 | 91 | 80 | 81 | 379 |
| 23 | 64 | 65 | 81 | 84 | 66 | 360 |
| 24 | 77 | 49 | 79 | 88 | 67 | 360 |
| 25 | 82 | 47 | 75 | 85 | 66 | 355 |

| S.No. | Academic Achievement | | | | | Total Achieve ment |
|-------|----------------------|-------|-------|---------|------------|--------------------------|
| | English | Hindi | Maths | Science | Social Sc. | |
| 26 | 68 | 67 | 95 | 94 | 71 | 395 |
| 27 | 72 | 47 | 84 | 80 | 65 | 348 |
| 28 | 75 | 43 | 77 | 65 | 64 | 324 |
| 29 | 67 | 72 | 78 | 86 | 71 | 384 |
| 30 | 84 | 47 | 68 | 84 | 71 | 354 |
| 31 | 76 | 40 | 83 | 79 | 65 | 343 |
| 32 | 73 | 57 | 82 | 77 | 74 | 363 |
| 33 | 66 | 42 | 81 | 71 | 66 | 326 |
| 34 | 62 | 62 | 75 | 73 | 63 | 335 |
| 35 | 69 | 47 | 60 | 82 | 69 | 327 |
| 36 | 71 | 58 | 50 | 78 | 75 | 332 |
| 37 | 61 | 66 | 85 | 90 | 79 | 381 |
| 38 | 54 | 57 | 80 | 81 | 66 | 338 |
| 39 | 83 | 76 | 50 | 74 | 67 | 330 |
| 40 | 70 | 66 | 82 | 74 | 74 | 366 |
| 41 | 69 | 61 | 41 | 76 | 68 | 315 |
| 42 | 62 | 62 | 81 | 83 | 66 | 354 |
| 43 | 71 | 66 | 75 | 84 | 77 | 373 |
| 44 | 57 | 73 | 75 | 82 | 75 | 362 |
| 45 | 49 | 57 | 50 | 52 | 62 | 270 |
| 46 | 57 | 55 | 38 | 65 | 65 | 280 |
| 47 | 53 | 55 | 60 | 64 | 59 | 291 |
| 48 | 62 | 69 | 62 | 76 | 67 | 336 |
| 49 | 60 | 67 | 47 | 65 | 69 | 318 |
| 50 | 62 | 68 | 75 | 78 | 58 | 341 |

| S.No. | Academic Achievement | | | | | Total Achievement |
|-------|----------------------|-------|-------|---------|----------------|-------------------|
| | English | Hindi | Maths | Science | Social Science | |
| 51 | 73 | 65 | 81 | 82 | 75 | 376 |
| 52 | 69 | 60 | 35 | 67 | 67 | 298 |
| 53 | 68 | 63 | 58 | 56 | 58 | 303 |
| 54 | 58 | 58 | 40 | 64 | 66 | 286 |
| 55 | 77 | 83 | 98 | 92 | 70 | 420 |
| 56 | 70 | 75 | 92 | 80 | 71 | 388 |
| 57 | 64 | 54 | 64 | 62 | 56 | 300 |
| 58 | 64 | 70 | 62 | 65 | 63 | 324 |
| 59 | 40 | 45 | 48 | 71 | 58 | 262 |
| 60 | 52 | 64 | 35 | 64 | 61 | 276 |
| 61 | 65 | 71 | 45 | 81 | 65 | 327 |
| 62 | 52 | 62 | 71 | 70 | 68 | 323 |
| 63 | 56 | 61 | 81 | 74 | 74 | 346 |
| 64 | 57 | 55 | 95 | 85 | 69 | 361 |
| 65 | 59 | 58 | 96 | 85 | 74 | 372 |
| 66 | 75 | 55 | 92 | 89 | 68 | 379 |
| 67 | 69 | 48 | 75 | 77 | 74 | 343 |
| 68 | 66 | 67 | 75 | 80 | 71 | 359 |
| 69 | 53 | 47 | 47 | 75 | 64 | 286 |
| 70 | 38 | 53 | 49 | 61 | 59 | 260 |
| 71 | 43 | 48 | 50 | 72 | 65 | 278 |
| 72 | 56 | 68 | 80 | 79 | 75 | 358 |
| 73 | 72 | 73 | 98 | 90 | 73 | 406 |
| 74 | 54 | 52 | 59 | 69 | 68 | 302 |
| 75 | 65 | 62 | 73 | 83 | 70 | 353 |
| 76 | 51 | 64 | 70 | 57 | 83 | 375 |

| S.No. | Academic Achievement | | | | | Total Achievement |
|-------|----------------------|-------|-------|---------|----------------|-------------------|
| | English | Hindi | Maths | Science | Social Science | |
| 77 | 54 | 70 | 75 | 83 | 69 | 351 |
| 78 | 56 | 56 | 95 | 87 | 64 | 358 |
| 79 | 58 | 38 | 62 | 74 | 72 | 304 |
| 80 | 45 | 35 | 64 | 69 | 64 | 277 |
| 81 | 51 | 36 | 81 | 76 | 69 | 312 |
| 82 | 46 | 43 | 69 | 84 | 73 | 315 |
| 83 | 43 | 58 | 60 | 56 | 51 | 285 |
| 84 | 54 | 65 | 68 | 68 | 64 | 319 |
| 85 | 52 | 41 | 48 | 55 | 60 | 256 |
| 86 | 41 | 58 | 58 | 64 | 68 | 289 |
| 87 | 53 | 69 | 84 | 75 | 68 | 349 |
| 88 | 36 | 58 | 82 | 63 | 60 | 299 |
| 89 | 55 | 53 | 41 | 61 | 70 | 280 |
| 90 | 50 | 55 | 82 | 73 | 70 | 330 |
| 91 | 54 | 58 | 68 | 67 | 65 | 312 |
| 92 | 40 | 52 | 62 | 62 | 71 | 287 |
| 93 | 54 | 63 | 68 | 67 | 65 | 317 |
| 94 | 48 | 58 | 71 | 63 | 49 | 289 |
| 95 | 71 | 70 | 82 | 90 | 67 | 380 |
| 96 | 52 | 56 | 48 | 55 | 60 | 272 |
| 97 | 54 | 61 | 42 | 63 | 65 | 285 |
| 98 | 44 | 65 | 72 | 79 | 68 | 328 |
| 99 | 51 | 62 | 84 | 76 | 67 | 340 |
| 100 | 59 | 65 | 46 | 65 | 71 | 306 |

APPENDIX II

Scores of Grade XI Science Girls

| S.No. | Academic Achievement | | | | | Total Achievement |
|-------|----------------------|-------|-------|---------|----------------|-------------------|
| | English | Hindi | Maths | Science | Social Science | |
| 1 | 78 | 61 | 76 | 67 | 50 | 332 |
| 2 | 78 | 59 | 94 | 85 | 74 | 390 |
| 3 | 68 | 57 | 52 | 55 | 36 | 268 |
| 4 | 67 | 47 | 56 | 55 | 36 | 261 |
| 5 | 78 | 50 | 72 | 59 | 36 | 295 |
| 6 | 69 | 43 | 54 | 53 | 40 | 259 |
| 7 | 73 | 53 | 74 | 74 | 74 | 348 |
| 8 | 66 | 49 | 72 | 67 | 58 | 332 |
| 9 | 77 | 50 | 44 | 78 | 66 | 315 |
| 10 | 71 | 51 | 72 | 55 | 40 | 289 |
| 11 | 65 | 54 | 54 | 56 | 42 | 271 |
| 12 | 63 | 46 | 80 | 62 | 36 | 287 |
| 13 | 61 | 34 | 60 | 60 | 36 | 251 |
| 14 | 72 | 57 | 60 | 63 | 58 | 310 |
| 15 | 78 | 57 | 76 | 68 | 50 | 329 |
| 16 | 67 | 55 | 58 | 73 | 72 | 325 |
| 17 | 72 | 45 | 54 | 67 | 48 | 286 |
| 18 | 74 | 54 | 72 | 71 | 60 | 331 |
| 19 | 80 | 58 | 82 | 77 | 70 | 367 |
| 20 | 78 | 45 | 62 | 70 | 68 | 323 |
| 21 | 79 | 57 | 48 | 64 | 56 | 304 |
| 22 | 77 | 58 | 90 | 80 | 68 | 373 |
| 23 | 71 | 40 | 50 | 58 | 40 | 259 |
| 24 | 77 | 50 | 66 | 68 | 56 | 317 |
| 25 | 83 | 57 | 54 | 74 | 70 | 338 |

| S.No. | Academic Achievement | | | | | A. ma. |
|-------|----------------------|-------|-------|---------|-------------------|-----------|
| | English | Hindi | Maths | Science | Social Science | |
| 26 | 80 | 51 | 58 | 65 | 54 | 308 |
| 27 | 74 | 54 | 74 | 65 | 48 | 315 |
| 28 | 78 | 43 | 66 | 65 | 58 | 310 |
| 29 | 76 | 52 | 68 | 74 | 74 | 344 |
| 30 | 72 | 51 | 70 | 73 | 68 | 334 |
| 31 | 72 | 50 | 76 | 73 | 52 | 323 |
| 32 | 72 | 51 | 66 | 66 | 48 | 303 |
| 33 | 81 | 48 | 72 | 67 | 48 | 316 |
| 34 | 77 | 55 | 80 | 78 | 80 | 370 |
| 35 | 85 | 53 | 79 | 77 | 76 | 370 |
| 36 | 82 | 50 | 74 | 71 | 56 | 333 |
| 37 | 75 | 48 | 54 | 58 | 46 | 281 |
| 38 | 71 | 50 | 88 | 90 | 74 | 373 |
| 39 | 88 | 59 | 92 | 80 | 84 | 403 |
| 40 | 85 | 65 | 54 | 83 | 88 | 380 |
| 41 | 75 | 52 | 80 | 69 | 60 | 336 |
| 42 | 78 | 56 | 94 | 82 | 70 | 380 |
| 43 | 83 | 53 | 80 | 69 | 52 | 337 |
| 44 | 80 | 68 | 92 | 88 | 62 | 390 |
| 45 | 88 | 77 | 88 | 89 | 60 | 402 |
| 46 | 72 | 58 | 74 | 72 | 40 | 306 |
| 47 | 76 | 68 | 78 | 80 | 48 | 350 |
| 48 | 84 | 71 | 84 | 86 | 48 | 373 |
| 49 | 84 | 74 | 88 | 86 | 50 | 382 |
| 50 | 72 | 51 | 70 | 67 | 36 | 296 |

| S.No. | Academic Achievement | | | | | Total Achievement |
|-------|----------------------|-------|-------|---------|------------|-------------------|
| | English | Hindi | Maths | Science | Social Sc. | |
| 51 | 72 | 61 | 70 | 72 | 48 | 323 |
| 52 | 75 | 57 | 72 | 70 | 40 | 314 |
| 53 | 70 | 44 | 56 | 61 | 36 | 267 |
| 54 | 75 | 71 | 88 | 76 | 52 | 362 |
| 55 | 77 | 61 | 76 | 73 | 44 | 331 |
| 56 | 71 | 63 | 72 | 68 | 36 | 310 |
| 57 | 70 | 55 | 50 | 51 | 36 | 262 |
| 58 | 78 | 57 | 58 | 61 | 56 | 310 |
| 59 | 84 | 69 | 88 | 84 | 70 | 395 |
| 60 | 80 | 70 | 82 | 83 | 56 | 371 |
| 61 | 74 | 65 | 84 | 69 | 36 | 326 |
| 62 | 75 | 62 | 60 | 56 | 36 | 289 |
| 63 | 74 | 47 | 76 | 67 | 42 | 306 |
| 64 | 74 | 48 | 58 | 64 | 38 | 282 |
| 65 | 85 | 65 | 76 | 77 | 50 | 353 |
| 66 | 75 | 53 | 78 | 71 | 50 | 327 |
| 67 | 72 | 55 | 70 | 63 | 36 | 296 |
| 68 | 85 | 55 | 70 | 69 | 46 | 325 |
| 69 | 73 | 62 | 74 | 67 | 50 | 326 |
| 70 | 83 | 71 | 88 | 86 | 66 | 394 |
| 71 | 76 | 63 | 72 | 68 | 36 | 315 |
| 72 | 75 | 53 | 56 | 66 | 46 | 296 |
| 73 | 76 | 58 | 78 | 81 | 52 | 345 |
| 74 | 77 | 47 | 46 | 59 | 38 | 267 |
| 75 | 80 | 60 | 80 | 76 | 36 | 332 |

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| S.No. | Academic Achievement | | | | | Total Achieve ment |
|-------|----------------------|-------|-------|---------|------------|--------------------------|
| | English | Hindi | Maths | Science | Social Sc. | |
| 76 | 52 | 60 | 48 | 63 | 63 | 286 |
| 77 | 57 | 60 | 60 | 62 | 65 | 304 |
| 78 | 50 | 66 | 90 | 77 | 67 | 350 |
| 79 | 68 | 60 | 80 | 84 | 81 | 374 |
| 80 | 61 | 44 | 36 | 63 | 64 | 268 |
| 81 | 64 | 58 | 69 | 77 | 68 | 336 |
| 82 | 47 | 36 | 36 | 48 | 39 | 206 |
| 83 | 63 | 54 | 36 | 52 | 47 | 252 |
| 84 | 54 | 41 | 86 | 64 | 63 | 308 |
| 85 | 43 | 36 | 82 | 70 | 66 | 297 |
| 86 | 64 | 36 | 36 | 45 | 52 | 243 |
| 87 | 59 | 37 | 36 | 60 | 50 | 242 |
| 88 | 51 | 36 | 62 | 63 | 53 | 264 |
| 89 | 50 | 62 | 71 | 59 | 47 | 289 |
| 90 | 68 | 46 | 61 | 52 | 67 | 294 |
| 91 | 55 | 36 | 36 | 48 | 45 | 220 |
| 92 | 69 | 36 | 68 | 73 | 75 | 322 |
| 93 | 61 | 57 | 77 | 75 | 61 | 331 |
| 94 | 75 | 39 | 71 | 63 | 58 | 306 |
| 95 | 73 | 44 | 52 | 57 | 51 | 277 |
| 96 | 60 | 36 | 81 | 78 | 60 | 315 |
| 97 | 51 | 36 | 62 | 63 | 53 | 264 |
| 98 | 69 | 50 | 39 | 57 | 77 | 292 |
| 99 | 65 | 59 | 54 | 80 | 66 | 324 |
| 100 | 64 | 50 | 66 | 71 | 63 | 313 |